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(54) Heel for sho

(57) An upwardly open, hollow heel 1 has at least one soft elastic bearing element 12 between the bottom profiled outsole 2 and insole 10. The bearing element 12 is an absorption element made of rubber or plastics having a high intrinsic shock-absorption characteristic. Many alternative arrangements of the heel body and the bearing element are disclosed, some arrangements including springs in addition to the bearing element.

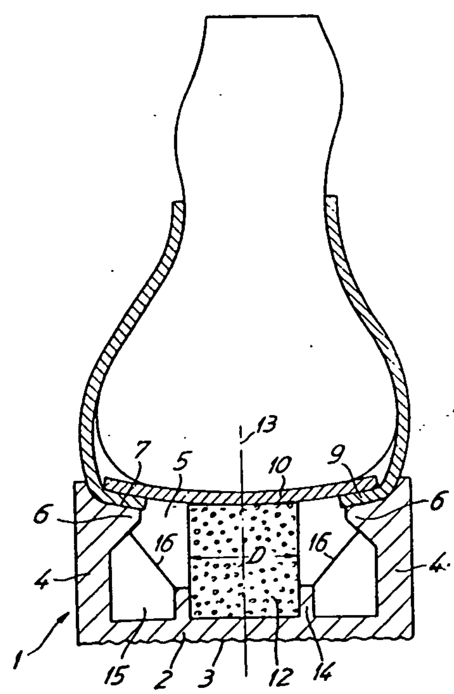

Fig.1

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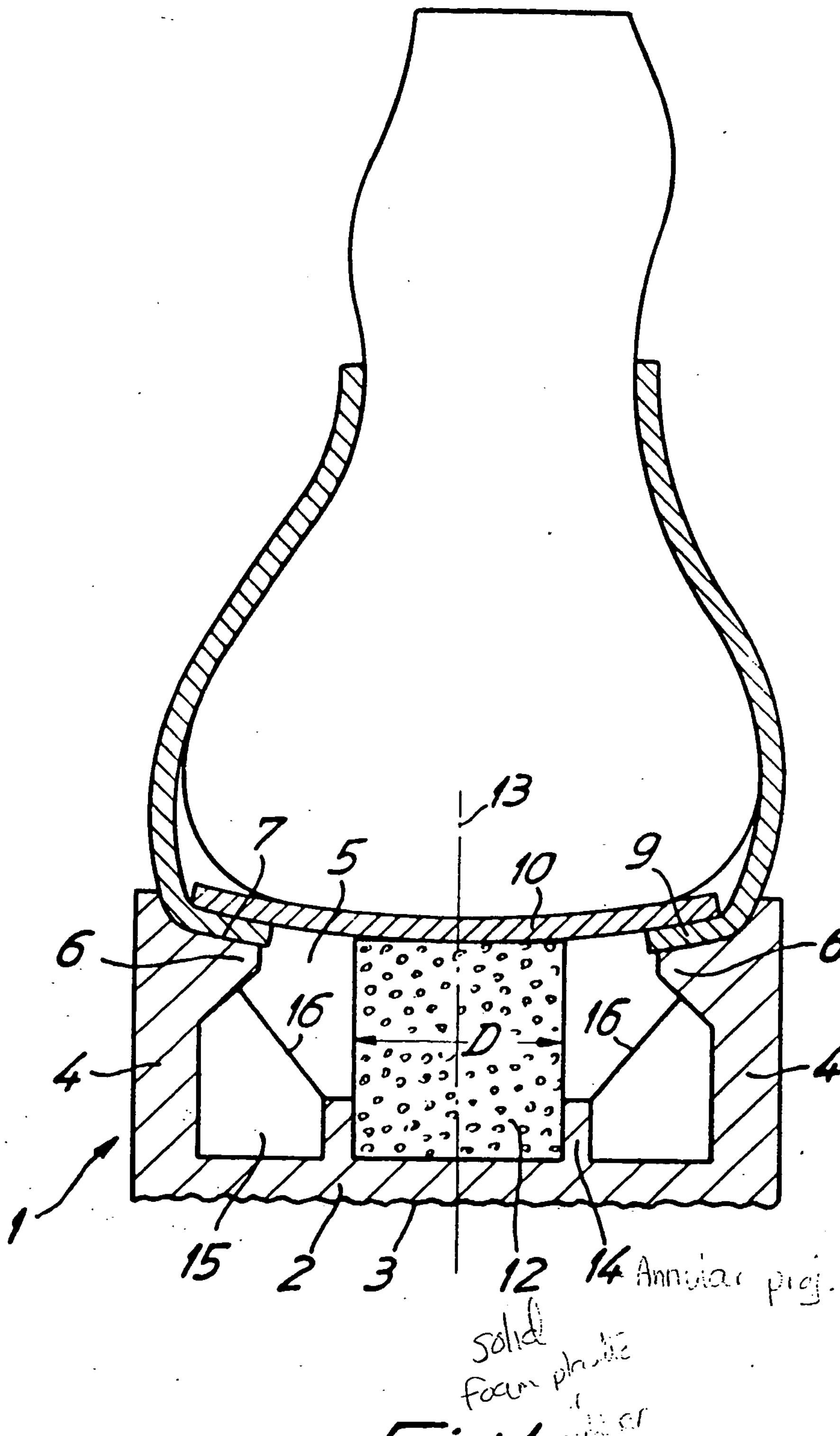
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Fig.1

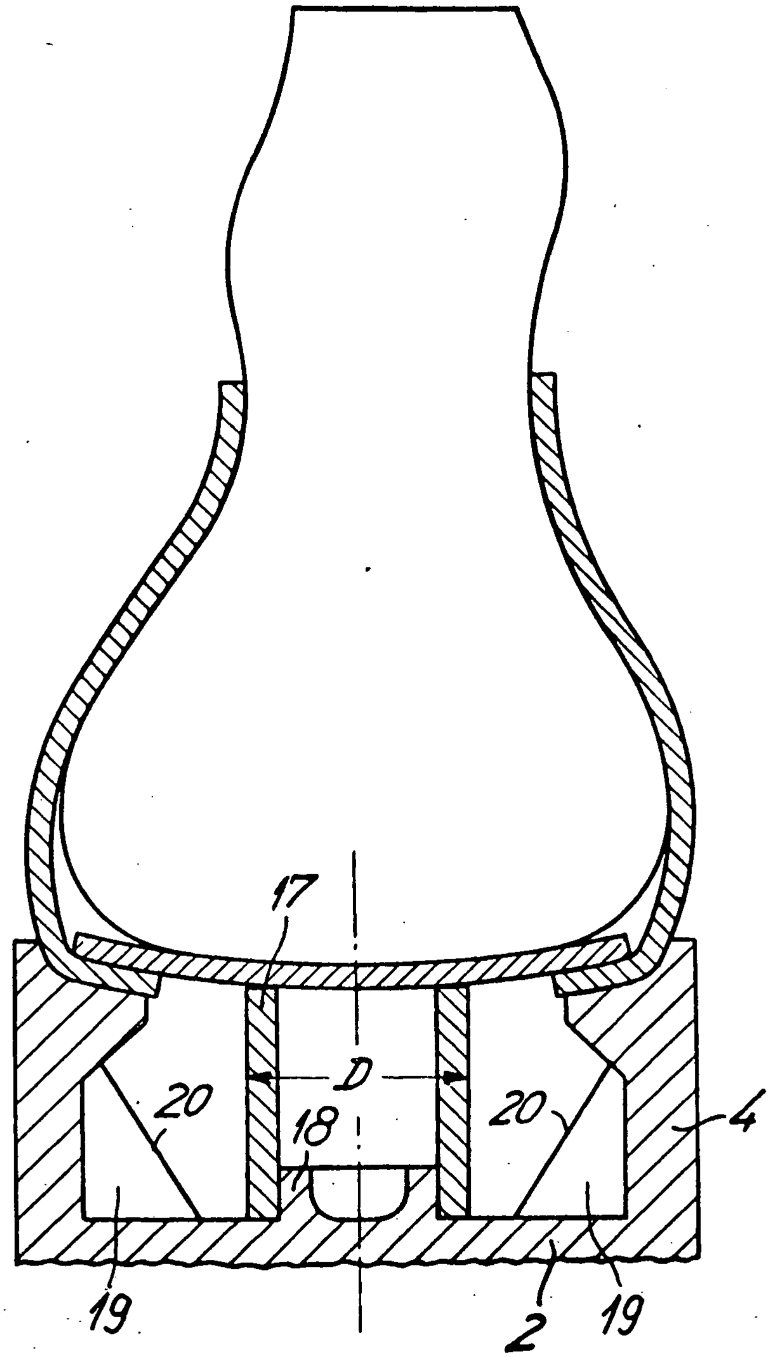


Fig.2

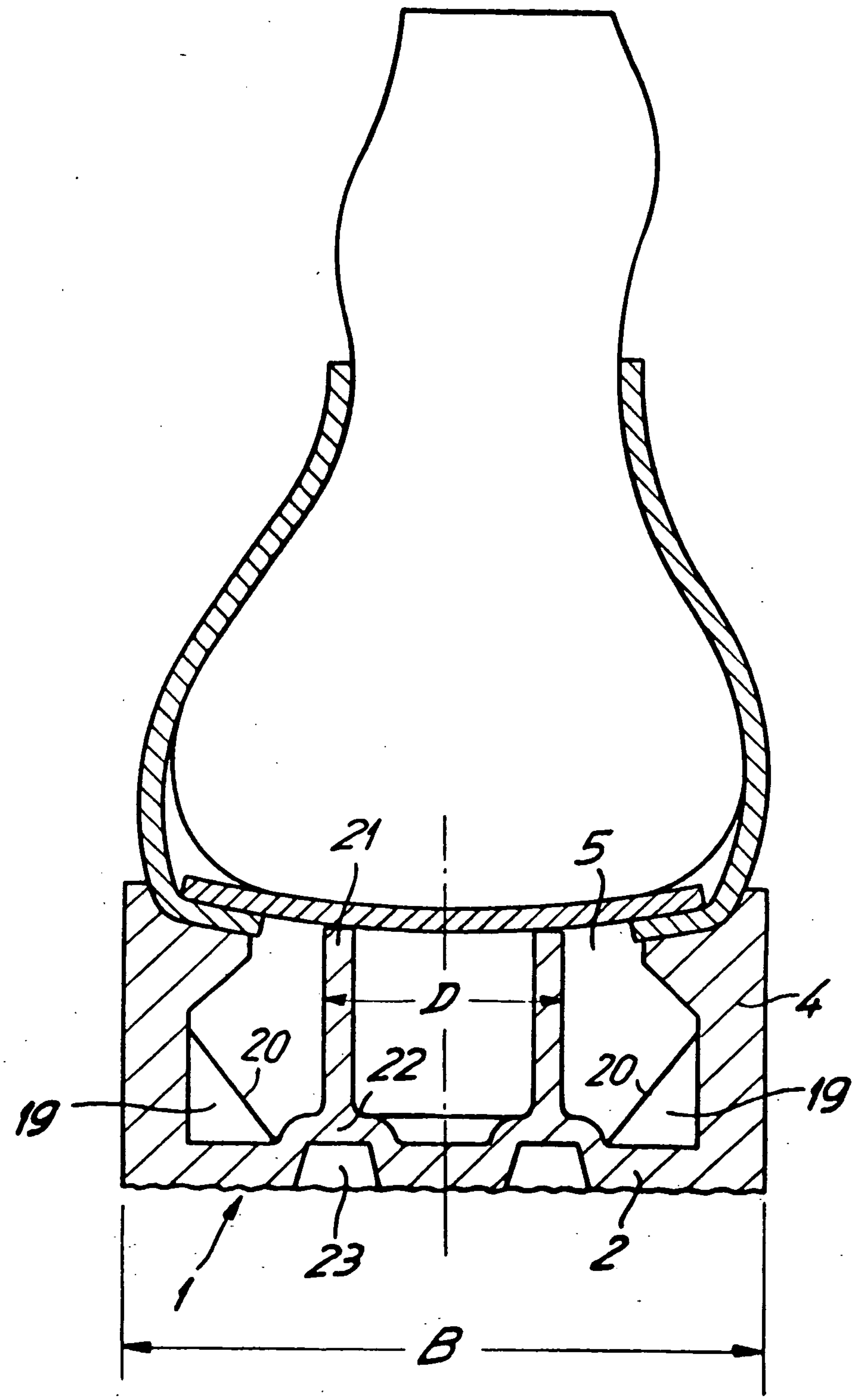


Fig.3

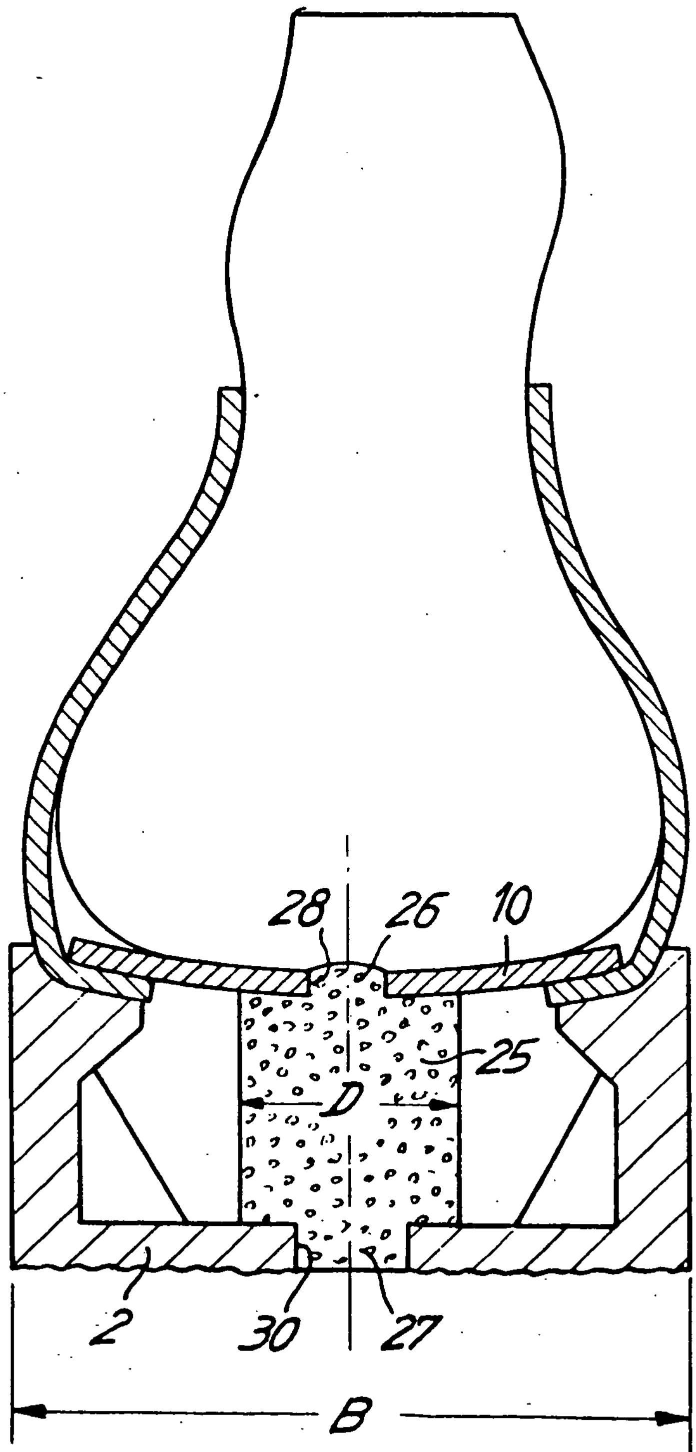


Fig.4

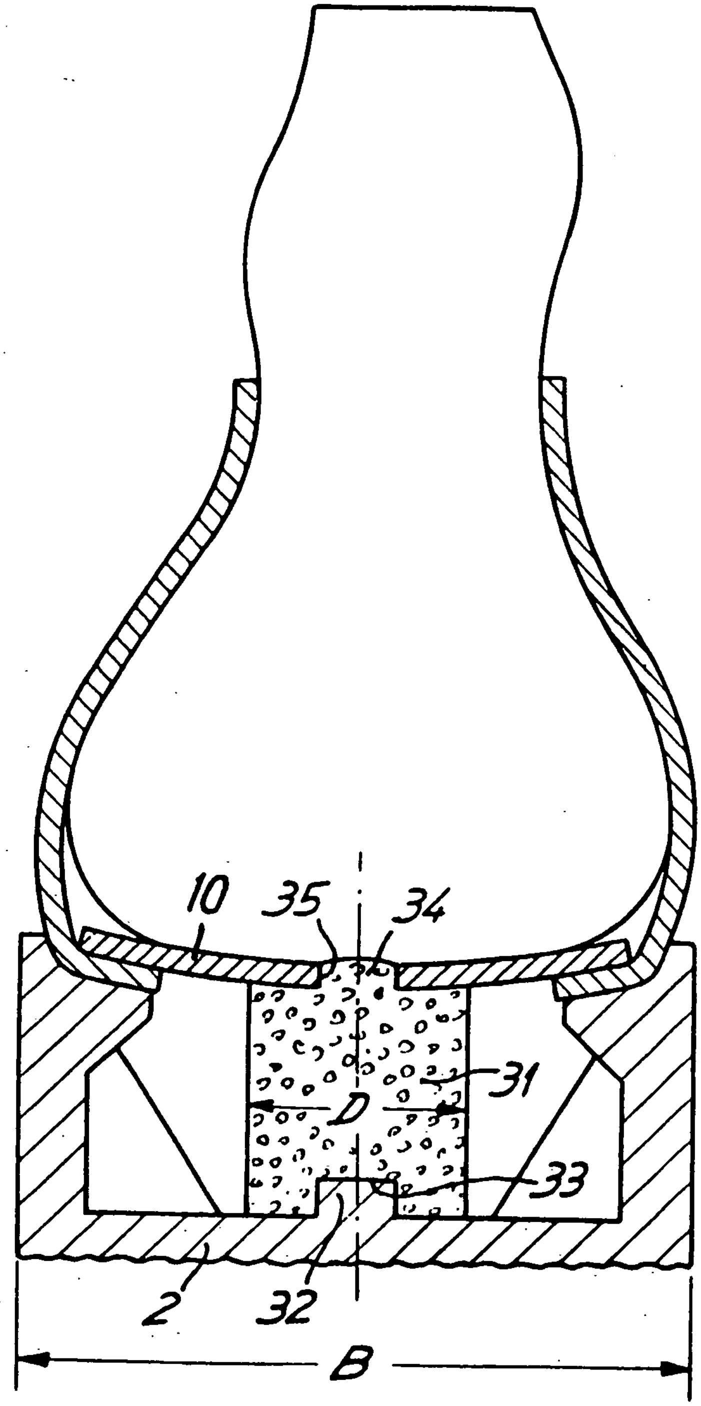


Fig.5

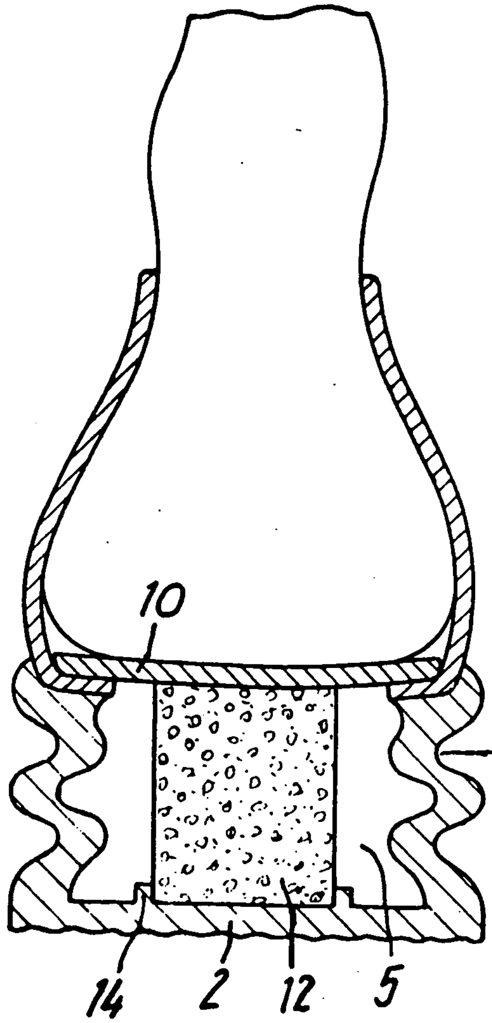


Fig. 6

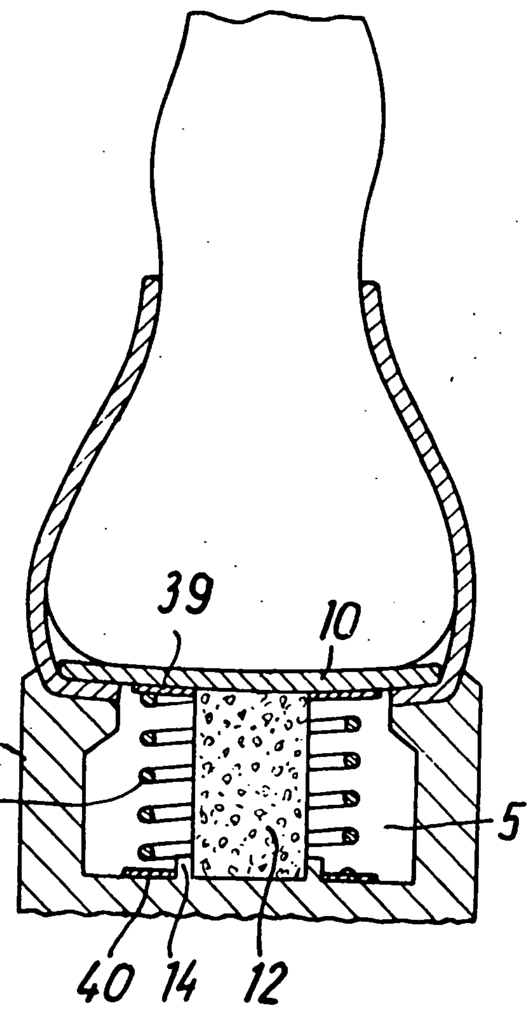


Fig. 7

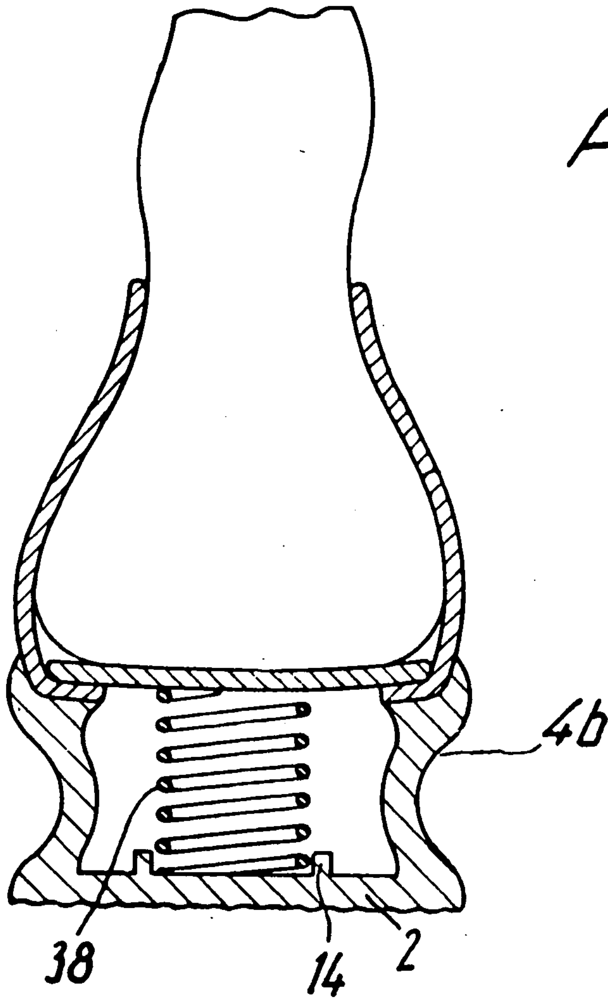


Fig. 8

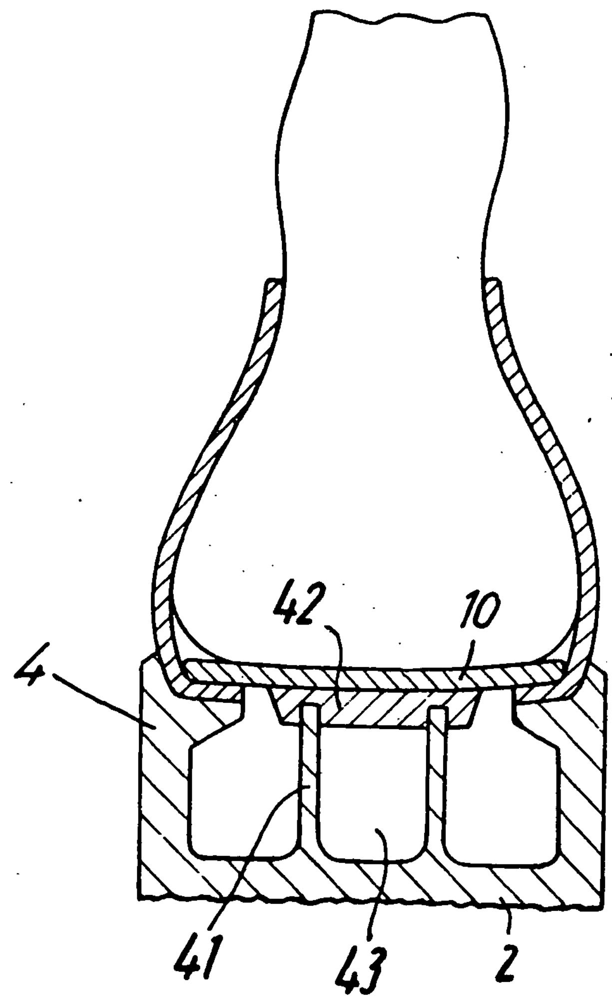


Fig. 9

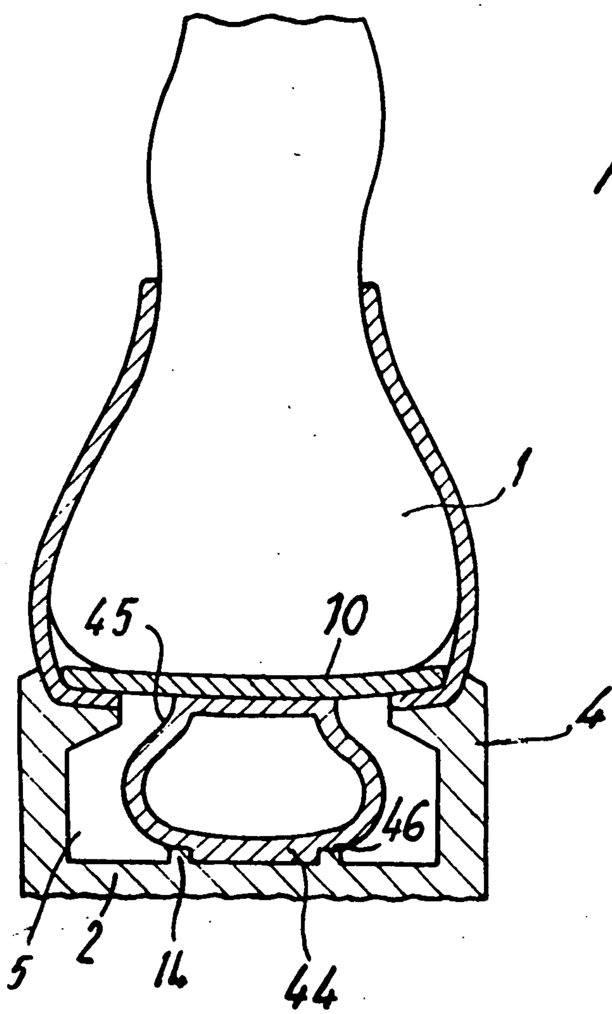
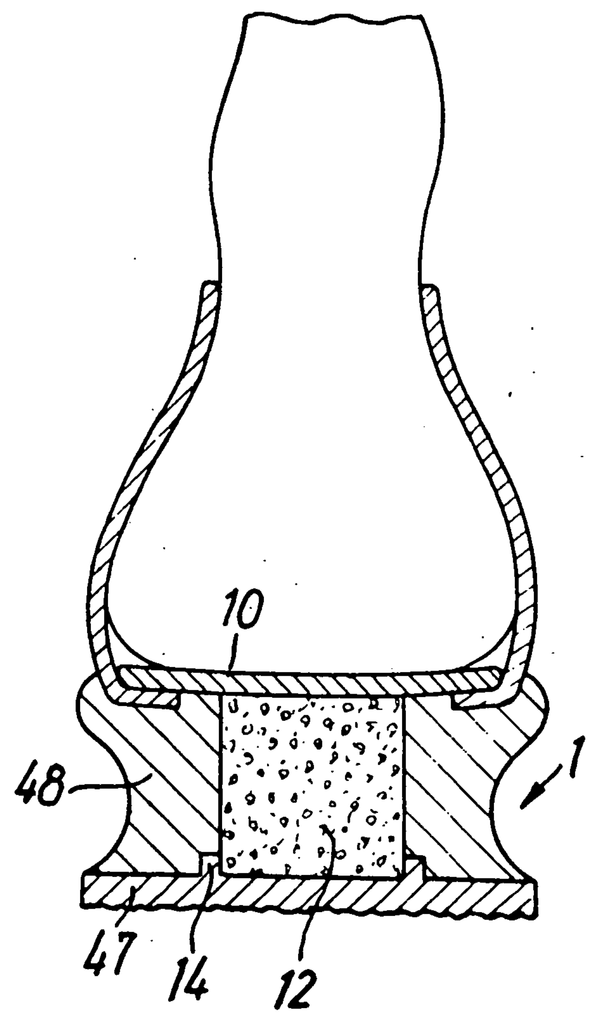


Fig. 10

Fig. 11



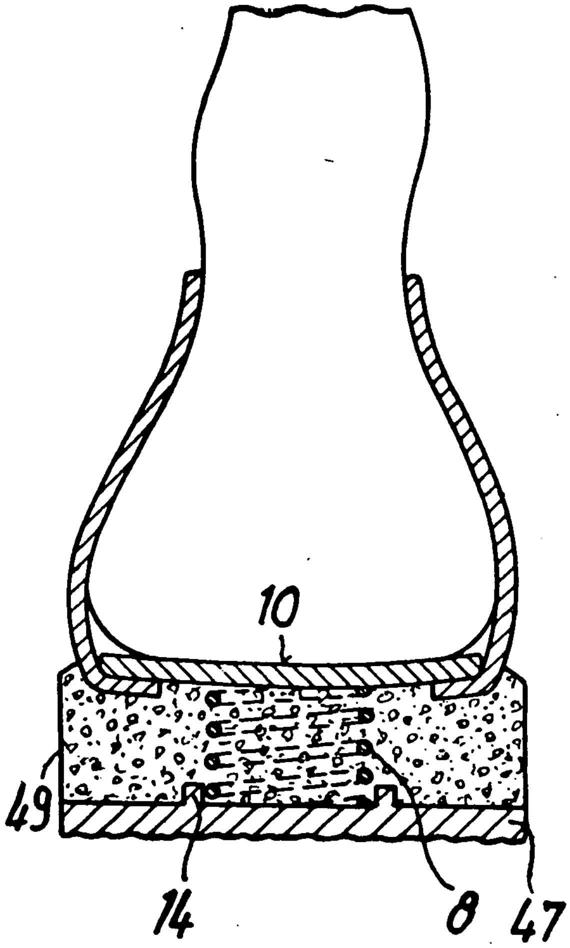


Fig. 12

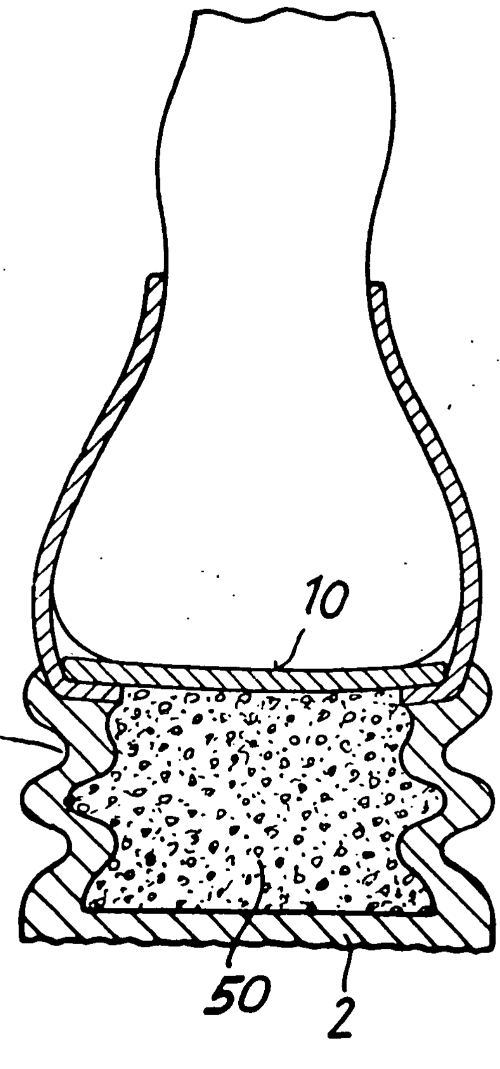
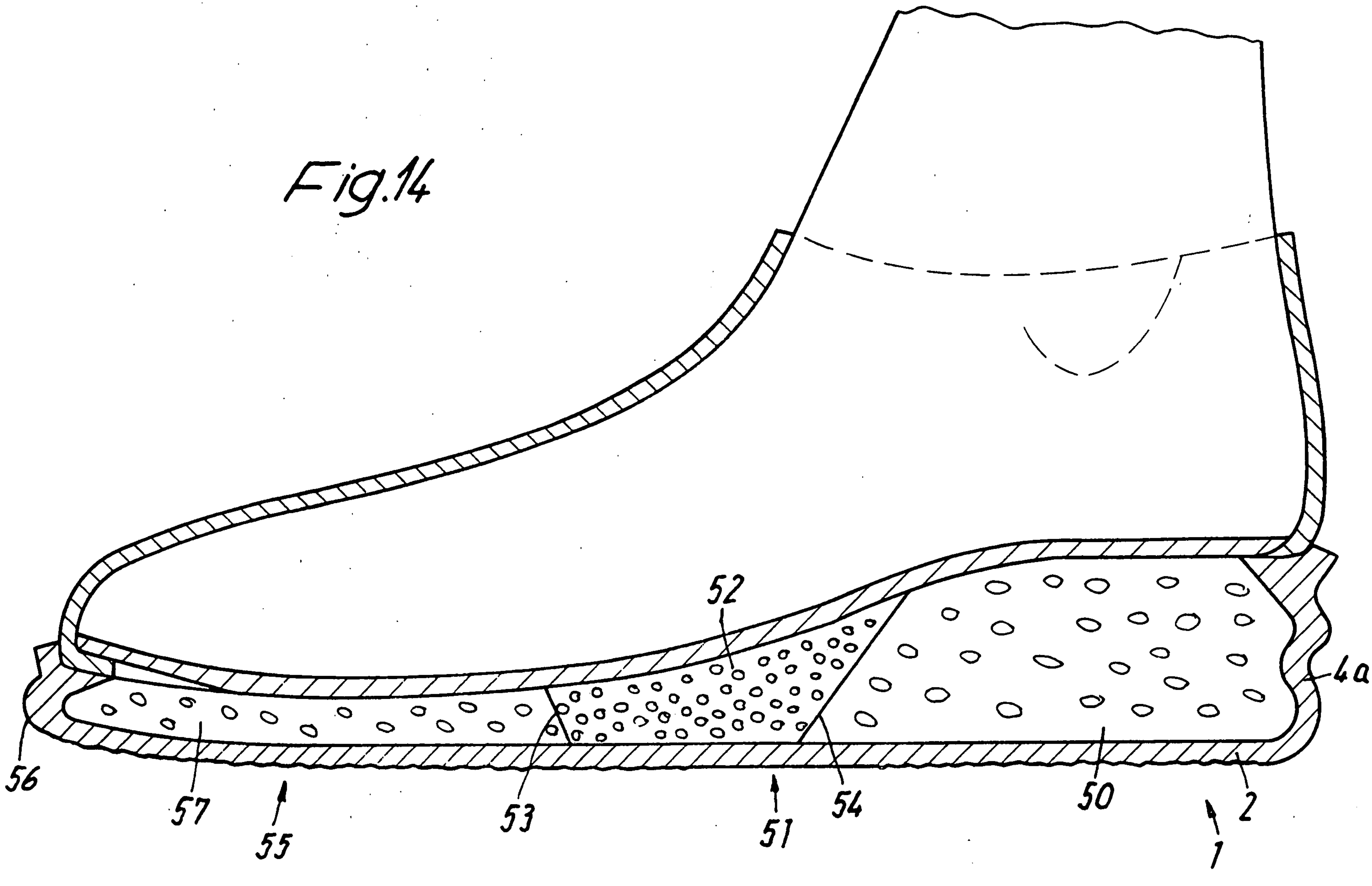


Fig. 13

Fig.14



SPECIFICATION

Pr fabricated s l for sh e

The invention relates to a prefabricated shaped sole having a hollow heel in which at least one soft resilient bearing element is disposed between the insole and the outsol , which is profiled.

Recent research in orthopaedic clinics has shown that the energy absorption capacity in the heel region of shoes has a very important effect on the durability and compatibility of implanted artificial joints. The aforementioned research is particularly important in the case e.g. of safety shoes, sports shoes and/or normal shoes in the event of fractures to the heel bone or injuries to the ankle joint, since if allowance is made for the research results, the aforementioned shoes can be given health-promoting properties. For example, the capacity to absorb kinetic energy of impact can be increased so that the impacts during walking, running and jumping can be at least partly absorbed and consequently attenuated by the shoe heel, thus reducing the effect of the impact on the bone structure and joints. The research has also shown that the resilience, more particularly in the heel region of the shoe, is not the important factor, as has previously been assumed, but the shock-absorbing properties of shaped soles, more particularly in the heel region are much more important in relieving the joints.

In order to obtain maximum spring-back resilience of the shoe heel it is known, e.g. from German Patent Specification No. 478,836 to dispose a soft rubber cylindrical resilient element in the cavity of a rubber heel, whereas the heel tread is made of hard rubber and has a projecting elevated portion in the neighbourhood of the spring element. As soon as the heel is loaded, the convex part of the tread tries to return to the level of the rest of the tread, thus compressing the spring. The spring element is sufficiently soft to prevent any perceptible pressure being transferred to the foot. However, owing to the hard, almost rigid edges of the sole, the wearing properties of this shoe heel are inadequate since, as is known, the rear hard edge of the sole is the first part of the wearer's foot to touch the ground and is therefore heavily loaded.

There are also various known means of obtaining resilient properties in the heel region of a moulded sole (e.g. German Utility Model 72 39 469, French Patent Specification 1 527 793 and German Patent Specification 570 919), in which a porous foam material is disposed in the heel region in order, as before, to obtain a very intensive resilient effect.

The initially-mentioned requirements regarding high energy absorption are most satisfactorily fulfilled by one-piece shaped soles with hollow heels made of resilient rubber or plastics. For reasons of stability, however, the sole heels are divided by integrally-formed, vertical webs into a number of chambers, the webs being made of the same tough, relatively hard material as the outsoles, so that the absorption of impact energy is inadequate.

An object f the invention, in the case of a shoe sol of the initially-mentioned kind, is to improve the energy absorption capacity at least in th heel region without adv rsely affecting other properties of th sol , .g. without increasing the wear or weight, and thus r duce the impact stresses on the bone structure and joints.

To this end, according to the invention, th impact-absorbing bearing element disposed in the h el constitut s a shock-absorbing el ment made of rubber or plastics having high intrinsic absorption.

According to the invention the shaped sole heel is constructed so as to make substantial reduction in impact stresses on the bone structure and joints, as a result of the energy absorption capacity of the shock-absorbing element. As a result of the central position the shape and more particularly, the high intrinsic absorption characteristics of the material used for the shock-absorbing element, the shoe heel adequately absorbs loads in the central region of the heel of the foot, and the entire shoe heel has particularly advantageous deformation properties in response to the abrupt stresses occurring during walking, jumping or running. The plastics or rubber used is said to have "high intrinsic absorption", i.e. specific deformation behaviour, consisting in delayed resilient recovery of the shape of the b aring element after an impact. The shaped sole is particularly suitable for safety shoes since its high energy absorption capacity is considerably above the values stipulated in German Standard DIN 4843. Shoes equipped with the aforementioned shaped soles have been found particularly suitable for mountaineering since they effectively reduce the high stresses on the heels of the feet during descending, thus greatly relieving the joints.

Plastics or rubber foamed materials ideally meet the requirements on the shock-absorbing element according to the invention, owing to their high specific absorption characteristics and low specific gravity. Accordingly, in a preferred embodiment of the invention, the bearing element is made of foamed plastics or foamed rubber. One particularly advantageous feature of the last-mentioned embodiment is that the properties of foamed plastics can be adjusted very accurately and within very wide limits, by suitably choosing the individual components and the foaming properties, so as to obtain a specific shock-absorption characteristic depending on the special use which is to be made of the soles. Ev n if the soles are themselves made of foamed material the manufacturing process can advantageously be simplified if the absorption elements are made in one operation together with the soles. Advantageously the absorption elements are made in the form of hollow cylinders and merge into the actual outsole in a thin-walled region formed by an annular sectional groove in the outsole.

The wearing properties of a shoe are gr atly improved simply by providing a shock-absorbing element in the heel region, but a considerable further improvement can be made if the shock-absorbing element is associated with a s cond resilient bearing element in the heel region. This gives an optimum combined effect, the absorption and the resilient properties can be very closely matched to one another, at least in the heel region by a suitable choice of materials and/or by suitably shaping the

individual components. When a shoe equipped with the shaped sole is worn, the two bearing el ments in the heel region (i.e. the absorption element and the resilient element) are in constant interaction and specific requirements on the shoe, e.g. in various sports, can be met in a very simple manner by suitably matching the shock-absorbing and resilient properties of the two bearing lements. This applies particularly to running and jumping sports, in which relatively high spring-back resilience in the heel region is desired together with absorption of peak stresses.

The intended aims can be obtained in particularly simple manner if the outer heel wall forms the resilient element by being made of suitably shaped rubber of plastics, whereas a shock-absorbing element made likewise of foam or plastics having high intrinsic absorption is disposed in the inner heel cavity. The reverse arrangement is also possible, however, depending on the adjustment of the chosen foam materials. Resilient elements of various kinds and shapes can be used in the heel. The elements can be e.g. helical springs, sealed air chambers and bellows, resilient heel-side walls in the form of bellows, etc. A steel helical spring, for example, has very favourable resilience compared with other kinds of spring and can be disposed either inside the shock-absorbing element, e.g. by being embedded in plastic foam or can surround the shock-absorbing element, which in that case will be cylindrical. In the latter case, additional shock-absorption can be obtained by a suitable choice of material and/or by suitably shaping the outer heel walls.

In a recent process of manufacturing sports shoes, the tread, and only the tread, of the sole is prefabricated from wear-resistant, mechanically strong material, whereas the tread is secured to the shoe and the sole walls are simultaneously formed from foamed or poured PUR foam. The invention can also be applied to sports shoes made by this process, if the resilient and/or shock-absorbing element is in the form of a continuous pad applied to the wear-resistant tread, after which the sides of the sole are formed and the sole is connected to the upper by foaming or pouring. In this method of manufacture, the bearing elements can be completely embedded in foam material.

If the shaped sole has to be directly foamed on the under-surface of the upper, the shock-absorbing and/or resilient element can be secured to the underside of the insole, and can then be embedded in foamed sole material. If the material is suitably selected and/or the foamed sole material is suitably shaped, the sole can act as either a resilient or a shock-absorbing bearing element.

With regard to the desired good wearing properties, the main effect is obtained by suitable combination of resilient and shock-absorbing elements, using either a maximum restoring force or an increased shock-absorbing effect. The various properties can be exactly adjusted by using foamed plastics. For example, the resilient elements can be made of soft polyester-based PUR foam of relatively high density (0.5 to 0.7) combined if required with suitable shaping, e.g. bellow-like he l walls. The aforementioned PUR soft foam gives excellent resilience, high restoring force and relatively low internal friction. On th other hand, very advantageous shock-absorbing properties are obtained if the shock-absorbing element is made of soft polyether-bas d PUR foam having relatively low density (about 0.2 to 0.4). This material has a relatively high shock-absorbing effect, i.e. when it contracts it can effectiv ly absorb relatively larg , abrupt loads by internal friction and delayed return to its original shape. Of course, the aforementioned materials are given only by way of example, since corresponding effects can be obtained by various other materials and/or shapes. If steel springs must not be used inside a sole but the resilient element has to have equally high restoring forces, it can be made of highly cross-linked synthetic rubber containing a low proportion of filler. Vulcanized moulded members made e.g. of CIS-polybutadiene have a Shore hardness A 75 and a spring-back resilience of 97% and are thus particularly suitable as resilient elements inside the heel, in which case the heel wall will be constructed as a shock absorbing element.

As a result of the special shape of the shock-absorbing and resilient elements, shaped soles according to the invention are also suitable for "anti-static" footwear, which must have current-flow resistance which does not fall below a prescribed value. In the last mentioned specific embodiment, the shock-absorbing element is made of conductive material and provides a conductive connection between the insole and the sole tread. To this end, at least one projection is formed on each end face of the resilient element and extends through a corresponding recess in the part of the shoe in question and its outer surface is substantially flush with the outer surface of the part of the shoe. Consequently, conductive safety shoes can be manufactured without reference to the conductivity of the sole material, and this simplifies manufacture and storage. The conductive shock-absorbing element is disposed under the heel bone, which very effectively eliminates static charges, since the heel always strikes the ground first during walking and thus makes contact with earth at the highest pressure. Consequently, any charge can be safely eliminated at the beginning of each step.

Some embodiments of the invention will now be described in detail with reference to the drawings, in which:

Figures 1 to 5 show various embodiments of the shaped sole according to the invention in vertical section in a plane through the centre of the heel bone;

Figures 6 to 13 show other embodiments of the shaped sole according to the invention, each comprising a shock-absorbing element and a resilient element in the heel, and

Figure 14 shows a shoe having a shaped sole having matched resilient and shock-absorbing properties along its entire length and width.

In the following description like references will be used for like parts of the various embodiments of a shoe.

Figure 1 shows an embodiment in which the heel

region 1 of a prefabricated shaped sole comprises an outsole 2 having a profiled tread 3 and vertical side walls 4 which co-op rate with the outsole 2 to form a heel cavity 5. At the top, walls 4 ar widened by a peripheral projection 6 or a number of separate inwardly- xtending proj ctions 6 which form a dish-shaped adhesiv top surface 7 and a lat ral heel or dge 8. At the adhesive surface 7, the fold or gusset 9 is secured to the ins le 10 of the upper, e.g. by sticking, vulcanizing or foaming.

In the embodiment in Figure 1, a solid cylindrical shock-absorbing element 12 is disposed in the heel cavity 5 and is symmetrical with the central line 13 of the heel bone joint. Element 12 is made of soft resilient foamed plastics or rubber and is held in a predetermined position by an annular projection 14 formed on the inner surface of outsole 2 and fitting around the cylindrical element 12. Walls 4 are supported by a number of angularly-spaced stabilizing ribs 15 of suitable thickness, disposed in cavity 5 between annular projection 14, the inner surface of the outsole and walls 4. The ribs prevent excessive lateral deformation of the entire heel without appreciably influencing the desired energy absorption. As a result of ribs 15, the heel has a firm lateral grip even when walking on a slope. The radial inner surfaces 16 of ribs 15 are bevelled so that element 12 retains its full shock-absorbing effect and there is also a positive bearing connection between projection 14 and the inwardly-extending projection 6 of walls 4, which are subjected to particularly heavy stress. The rib material can be selected, depending on the size and nature of the radial inward projections 6, so that the ribs act as additional shock-absorbing elements, if the bearing element 12 is made of material having relatively high resilience.

The embodiment of a sole in Figure 2 has a basic structure similar to Figure 1, except that the shock-absorbing element in the central part of the hollow heel 1 is a separate hollow cylinder 17 of suitable length, secured by an annular projection 18 formed on the inside on outsole 2. Stabilizing ribs 19 having a bevelled inner surface 20 are disposed between the heel sides 4 and the outsole 2, but do not extend as far as the hollow cylindrical shock-absorbing element 17.

The embodiment of a sole in Figure 3 is made of foamed material having a resilience and intrinsic shock-absorption such that the central shock-absorbing element 21 can be formed integrally with the outsole 1. Element 21 is in the form of a short vertical hollow cylinder having comparatively thin walls, and its base 22, via an annular groove 23, is integral with the actual outsole 2. The reduced wall thickness in the transition region at groove 23, in conjunction with its bridge-like shape, results in additional elasticity and/or shock-absorption. The stabilizing ribs 19 have bevelled surfaces similar to the embodiment in Figure 2.

Figures 4 and 5 show heels for antistatic shaped sol s in which a shock-absorbing element 25, 31 respectively is s cured between insol 10 and outsole 2 in the heel cavity. In Figure 4, a spigot-like projection 26, 27 is formed on both end fac s f the shock-absorbing element 25 and engages in corresponding recesses 28, 30 of insole 10 and outsol 2. Element 25 is preferably made of foam d material which has the d sired shock-absorbing characteristic and also has exactly-defined conductivity and thus provid s an electric connection betw en the wearer's foot and the ground. In the embodiment in Figure 5, the sole material is itself conductive, which is advantageous in that there is no need for op n partition surfaces extending to th ground between the shock-absorbing element and the outsole, through which moisture could penetrate into the heel cavity. The shock-absorbing element 31 is secured in position by a short spigot-like projection 32 on outsole 2, which fits into a corresponding blind recess in element 31. A top spigot-like projection 34 is firmly secured in a corresponding recess 35 in insole 10, this improves the stability of positioning and also provides a conductive connection to the wearer's foot. In the last mentioned embodiment also, the antistatic conductivity of the shoe is better than that of known embodiments comprising a shaped sole made of conductive material, since the electric connection is via the conductive shock-absorbing element 31 except for a narrowly limited central part of sole 2.

In the embodiments in Figures 6 to 13, a shock-absorbing element in heel 1 is in each case associated with a purely resilient element. In Figures 6 and 7, the shock-absorbing element 12 is cylindrical as in Figure 1; in Figure 6 the resilient element is form d by corrugating the side wall *4a* of the sole, wher as in Figure 7 resilience is provided by a helical spring 38 surrounding element 12 and clamped in cavities 5 between stationary washers 39 and 40. In both embodiments, element 12 is secured by an annular projection 14 formed on the inner surface of the outsole. In the embodiment in Figure 7, washers 38, 39 improve the pressure distribution and the durability.

In the embodiment in Figure 8, the resilient le- ment is likewise a helical spring 38 secured in position at the bottom part of outsole 2 by an annular projection 14. In Figure 8, the side walls *4b* of the heel have a shock-absorbing effect, they are internally convex and made of material having high intrinsic shock-absorbing properties.

In the embodiment in Figure 9, the heel has straight side walls 4. Outsole 2 is formed int grally with inner walls 41 which co-operate with a gas-tight cover 42 stuck to their top end to bound a gas or air chamber 43. If the heel is compressed by being st p- ped upon, the inner walls 41 co-operate with the heel walls 4 to absorb shocks, and the enclosed air is simultaneously compressed and acts as a resilient element having a restoring force when the load is removed.

In the embodiment in Figure 10, the air chamber is constructed as a separate bladder 44 secured between insole 10 and outsole 2, e.g. by sticking. Bladder 44 which is filled with compressed gas can be a completely separate rubber ball or similar structur and can have a thickened top projection 45 for reliably bearing the heel bone and a bottom annular sh ulder 46 co-operating with the annular projection 14 formed on the bottom part or outsol .

In th mbodiment in Figure 11, the entire heel 1 is

made of solid material of varying consistency. A specially wear-resistant profiled part 47 has an annular projection 14 on its top surface for securing a cylindrical shock-absorbing element 12 made of suitable foamed material and having a surface which firmly abuts the undersurface of insole 10. The side walls of the heel are made of very resilient light foam 48 and extend to the outer surfac of the shock-absorbing element 5. The composition of foam 48 is adjusted so that the foam acts as a resilient element. The heel in Figure 12 has substantially the same structure as in Figure 6, except that a helical spring 38 secured in position by the annular projection 14 is disposed between the wear-resistant profiled part 47 and the insole 10. The shock-absorbing element is a pad 49 of light foam which fills the entire space between the under-surface of the upper or insole 10 and the wear-resistant part 47.

In the embodiment in Figure 13, the shaped sole is formed or foamed in a single manufacturing process on the under-surface of the upper or insole 10, after fixing the shock-absorbing element 50 to the under-surface or insole 3. The shock-absorbing part has a corrugated exterior having a shape exactly matching the corrugations of the side walls 4*a*. The materials for the outsole 2, walls 4*a* and pad 50 can be chosen so that either the walls act as a shock-absorbing element and pad 50 acts as a resilient element or conversely the pad acts as a shock-absorbing element and the walls act as a resilient element. The last-mentioned embodiment of the heel is particularly advantageous in that the shoe is very stable and safe to walk in since the entire heel cavity is filled by the shock-absorbing element and since the side surfaces of pad 50 are firmly secured to the side walls 4*a*. The entire heel, therefore, is a composite member which can absorb and uniformly distribute high stresses, even if they occur at a point. In addition, the sole is particularly simple to manufacture. To this end, a prefabricated pad element 50, the side surfaces of which correspond to the inner surfaces of the sides 4*a* of the sole, is secured in position in a mould or directly secured to the insole 3, after which the outsole of the heel is integrally formed on the upper by pouring or filling with foam. The connected bellow-like shape of the side walls 4*a* improves the resilience of the entire heel, and the shock-absorption and resilience of the heel is greatly improved by the adhesive joint between the inner pad element 50 and the inner surface of the insole.

The invention is not limited to the embodiments shown, and various methods and features thereof can be combined to form new variants. In view of the advanced state of PUR foam technology, the properties of the finished products can be predetermined to obtain a wide range of variations. It is thus easy to ensure that the various moulded components of the sole according to the invention each have the required resilience and shock-absorbing properties. More particularly, th shock-absorption and resilience properties need not be restricted to the heel, the rest of the sole, more particularly the ball part of the tread, can be constructed to obtain optimum combined shock-absorption and resilience in the front part of the sole also. Advantageously, to obtain optimum wearing properties, the shape and/or material of the outsole is selected so that the sole walls in the ball region act as a resilient element, and the cavity in the sole is filled with a foam pad having high natural shock-absorption.

Since the resilience and/or shock-absorption of the various moulded parts can be exactly predetermined, manufacturers of e.g. sports shoes can for the first time manufacture shoes of a single kind, e.g. for a particular sport, having a number of various combinations of resilience and shock-absorption for each size of shoe. The wearer thus has the opportunity, out of a number of shoes of the same size, to choose the one which is e.g. most adapted to his own body weight and/or technique. This particularly applies to "endurance run" shoes, each size of which is worn by users having widely varying body weights, in view of the prolonged loading, it is particularly important to adjust the shoes to the individual capacities of the user.

Another possible adaptation to various user's requirements, as shown in the embodiments in Figures 9 and 10, is to provide the air chamber 43 or air bellows 44 with a valve (not shown), so that the inner pressure in the chamber can be adjusted by a simpl hand pump and thus adapt the shoe, e.g. to special short-term loads.

In addition, the inventive idea of a specific matching of resilience and shock-absorption can be applied to a complete moulded sole as shown in Figure 14. For example, various foam materials or the like can be used so that the cavities in heel 1 are filled with foamed material 50 having high shock-absorption whereas the heel walls 4*a* as in Figure 13 act as a resilient element or vice versa. A relatively rigid insert 52 can be disposed in the adjacent waist region 51 of the moulded sole and abut the insole 10 at the top and the outsole 2 at the bottom. The front and back surfaces 53, 54 of the insert 52 are oblique to ensure a gradual change in the properties of the sole. As before, a bearing and padding element 57 is disposed in the resilient or shock-absorbing sole edges 56 in the front or ball region 55 of the sole, the materials are chosen so that the shock absorption and resilience of pad 57 is adapted to that of the sole edge in order to obtain the inventive combination of shock-absorption and resilience. Elements 50 and 57 can be made of the same or different materials.

CLAIMS

1. A prefabricated shaped sole comprising an upwardly open, hollow heel and at least one soft elastic bearing element between the bottom profiled outsole and the insole, characterised in that the bearing element is an absorption element which absorbs the energy of impacts and is made of rubber or plastics having a high intrinsic shock-absorption characteristic.

2. A sole according to claim 1 characterised in that the shock-absorption element is made of foamed plastics or foamed rubber and is a separate component disposed substantially under the middle of the heel bone and having a diameter gr ater than a quarter of the width of the shoe heel and a height at least equal to its diameter, the absorption element being secured by retaining members in the heel cav-

ity.

3. A sole according to claim 2 characterised in that stabilizing ribs having an oblique inner surface are disposed in the heel cavity radially outside the absorption element between the sides of the heel and the outsole.

4. A sole according to claim 1 characterised in that the absorption element is integral with the outsol .

5. A sole according to any of the preceding claims characterised in that the absorption element is made of electrically conductive material and, at least one end face has a projection secured in corresponding recesses in the insole and/or in the outsole.

6. A sole according to any of the preceding claims characterised in that the absorption element is associated with a resilient element likewise disposed in the heel.

7. A sole according to claim 6 characterised in that the sides of the heel are corrugated in the form of a bellow and made of material having high resiliency or high intrinsic shock-absorption.

8. A sole according to claim 7 characterised in that the cavity bounded by the corrugated sides and bottom of the heel are completely filled with a resilient or shock-absorbing foam material.

9. A sole according to claim 6 characterised in that the resilient element comprises a helical spring clamped between the insole and the heel bottom.

10. A sole according to claim 6 characterised in that the resilient element comprises a resilient, gas-filled chamber in the heel cavity, having a wall which co-operates with the sides to form the shock-absorbing element.

11. A sole according to any of claims 6 to 10 characterised in that a cushion member made of foamed plastics or rubber is disposed between the insole and the outsole, which is flat and without edges and completely surrounds the resilient element which is disposed inside it.

12. A sole according to any of the preceding claims 6 to 11 characterised in that the resilient element and shock-absorbing element are given matching shapes and/or properties and are exchangeably inserted into the heel cavity before the outsole is attached to the shoe, so that shaped soles having the same standard size can have varying resilience and shock absorption.

13. A sole according to any of the preceding claims characterised in that a resilient element and/or a shock-absorbing element made of a material having high intrinsic absorption is also provided in the ball region.

14. A sole according to claim 13 characterised in that the resilient element comprises a soft foam pad filling the hollow interior of the shaped sole and the edges of the sole are made of a relatively hard, tough but likewise resilient foam material and form the shock-absorbing element.

15. A method of producing a shaped sole according to any of the preceding claims characterised in that a prefabricated bearing element having sides corresponding to the inner wall of the sole cavity is disposed in a fixed position in a moulding tool, after which the outsole is formed around the bearing element by casting or by filling the mould with foam.

16. A sole according to claim 13 characterised in that the co-operating resilient and shock-absorbing heel elements extend from the heel via the waist to under the balls of the toes.

17. A sole according to claim 16 characterised in that th co-operating resilient and shock-absorbing elements have three or more different resilient and shock-absorption properties adapted to the various requirements under the heel bone, the waist part and the toe balls.

18. A prefabricated shaped sole substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

19. A method of producing a shaped sole substantially as hereinbefore described.

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